REMARKS

Claims 1-67, including independent Claims 1, 11, 12, 18, 21, 24, 28, 42, 43, 49, 52 and 60, were pending. New claims 68-71 are added hereby, such that after entry of the amendments set forth above, Claims 1-71 will be pending, including the same-numbered independent claims.

The amendments set forth above add no new matter. Claims 46-47, 51 and 62 are each amended in response to the Claim Objections, substantially as suggested by the Examiner. Claim 19 is amended in response to the Examiner's comment on page 4 of the current Office Action that the first charge pump is implicit, but is not clearly identified in Claim 18. This is not a narrowing amendment, and indeed does not change the scope of the claim at all, but it may enhance clarity. New Claims 68-69 are supported, for example, by the Applicants' Figure 5. New Claims 70-71 are supported, for example, by paragraph 45 that bridges 10-11 of the application as filed.

Rejections Under 35 USC 112

On page 3 of the current Office Action, the Examiner rejects Claims 1-10, 12-17, 19-20 and 28-41 under 35 USC 112, second paragraph, as indefinite. In view of the comments he sets forth on page 5 of the current Office Action, in the same section of the current Office Action, the examiner apparently also intends to reject Claims 43 and 60 as indefinite. The examiner only provides direct reasons for indefiniteness rejections of Claims 1, 10, 12, 13, 18-19, 20, 28, 43, 60 and 62; Claims 2-9, 14-17 and 29-41 are therefore presumed to have been rejected by virtue of depending from one of the former set of claims, and by extension it is presumed that overcoming the rejections that the examiner supports with an express rationale will also overcome the rejection of the claims the examiner does not address directly.

Amendments to Claims 13, 19, 43, 60 and 62 obviate the corresponding definiteness rejections of those claims, and the amendment to Claim 19 also obviates the rejection of Claim 18. The rejections of Claims 1, 10, 12, 20, 28 and an aspect of Claim 43 are addressed in the remarks set forth below.

In regard to Claims 1 and 43, it is respectfully submitted that the phrasing "an odd number of not more than three inverting driver sections cascaded sequentially," while somewhat awkward, is not indefinite. As the Examiner correctly notes, the phrase implies that a ring oscillator may have just a single inverting driver section. Such single section is cascaded sequentially with itself. Because a ring oscillator is coupled from output to input, the coupling is circular, and the nominal "first" section is sequentially coupled to the nominal "output" section. Due to the current-starved nature of the ring oscillator, operation with just a single section is not a problem and indeed may produce a desirably sine-like output waveform. As such, the Applicant respectfully declines to omit such single-section oscillator from the scope of Claims 1 or 43. The

language of Claims 1 and 43 is admittedly not fine prose, but it adequately serves to encompass only one or three inverting driver sections. On the other hand, because a three-section ring oscillator is a preferred embodiment, the Applicant has added Claims 68 and 69, which omit coverage of single-section ring oscillators. Claims previously depending from Claim 1 or Claim 43 have been amended to depend from Claim 68 or 69, respectively, thus excluding single-stage ring oscillators from the scope of all claims depending directly or indirectly from Claim 1 or Claim 43.

The examiner's remarks demonstrate an understanding of the scope of Claims 1 and 43, providing support for a conclusion that these claims are not indefinite. The Examiner is reminded that to fail to satisfy 35 USC 112 paragraph 2, a claim must be "insolubly ambiguous" (*see, e.g.,* Bancorp Servs., L.L.C. v. Hartford Life Ins. Co., 359 F.3d 1367, 1372 (Fed .Cir. 2004)). It is respectfully submitted that Claims 1 and 43 are not insolubly ambiguous. As such, the Examiner is respectfully requested to withdraw this ground of rejection as to Claims 1 and 43.

The Examiner requests clarification of what is meant by "coupling substantial charge into the transfer capacitor via the charge pump clock input" as recited in Claim 10. The Applicant is pleased to provide such explanation, because two important topographies of charge pumps are distinguished from each other by their differences in this regard. The quoted language indicates that, in embodiments covered by Claim 10, (substantial) charge actually comes <u>from</u> the charge pump clock itself. In Figure 6 of the subject application, clock input CLK 524 does NOT couple substantial charge into the transfer capacitor. There may be a small amount coupled, in that embodiment, via the parasitic gate capacitances of the coupling switches 602, 604, 608 and/or 610, but it would not be substantial. In Figure 6, the primary conduction path for the transfer capacitor 606 is via the <u>channels</u> of said coupling switches, NOT via the clock input. Thus, Claim 10 does <u>not</u> read on the circuit of Figure 6. By contrast, Figure 7 illustrates an example of other embodiments described in the subject application, in which the current coupled into transfer capacitor 702 via the clock input CLK 524 is very substantial, indeed including all of such current; Claim 10 may read on such embodiments. Claim 10 thus underscores that embodiments described by Claim 1, which do not contain this limitation, may have either of these two distinct topologies.

In regard to Claim 19, the Examiner states (page 4 of the current Office Action from line 12) that it is not clear how the implied first stage from claim 19 relates to the switching devices and charge pump clock generating circuit cited within claim 18. Though the relationship is clear by normal canons of claim construction, Claim 19 as currently amended "expands" the description to reflect such normal canon of construction. The scope of Claim 19 is unchanged by such expansion of the language.

In regard to independent Claims 12 and 28, as well as dependent Claim 20, the examiner has repeatedly asked for illustrations or descriptions that precisely define the boundaries of a waveform that is "substantially sine-like." Compliance with this request is impossible without introducing new matter into the application, and in any event the description is adequately precise as it stands.

"Substantially" is a term that has long been approved for use in patent claims; indeed, the MPEP has a subsection specifically condoning the use of this term, subsection D of 2173.05(b) "Relative Terminology," and it is set forth below (underlining added for emphasis):

> The term "substantially" is <u>often used</u> in conjunction with another term to describe a particular characteristic of the claimed invention. It is a broad term. In re Nehrenberg, 280 F.2d 161, 126 USPQ 383 (CCPA 1960). The court held that the limitation "to substantially increase the efficiency of the compound as a copper extractant" was definite in view of the general guidelines contained in the specification. In re Mattison, 509 F.2d 563, 184 USPQ 484 (CCPA 1975). The court held that the limitation "which produces substantially equal E and H plane illumination patterns" was definite because one of ordinary skill in the art would know what was meant by "substantially equal." Andrew Corp. v. Gabriel Electronics, 847 F.2d 819, 6 USPQ2d 2010 (Fed. Cir. 1988).

The law is crystal clear that a claim is not indefinite unless it is "insolubly ambiguous."

> When a claim "is not insolubly ambiguous, it is not invalid for indefiniteness." Marley Mouldings Limited v. Mikron Industries, Inc., 417 F.3d 1356, 75 U.S.P.Q.2D 1954 (Fed. Cir. 2005), citing Bancorp Servs., L.L.C. v. Hartford Life Ins. Co., 359 F.3d 1367, 1372 (Fed .Cir. 2004).

Given that "substantially" is an acceptable term that is frequently used in just the manner it is used in the subject claims, and that "sine" is a precise mathematical description, it is easy to see that "substantially sine-like" covers a range of variation around a precise sine wave, yet limits coverage to waveforms that are substantially like a sine wave. Considering how difficult, awkward and unwieldy it would be to describe precise boundaries that give a fair range of play to such a waveform, and that most persons of skill in the art readily understand the meaning of "substantially sine-like," it is difficult to understand why the examiner continues to object to this term simply because it could be more precisely defined. Few English terms exist that are not susceptible of more precise definition.

At least one fact limits the scope of waveforms that may be construed as described by the term "substantially sine-like" in respect of the subject claims: the Applicants' insistence that the waveforms illustrated in the charge pump prior art of record is <u>not</u> substantially sine-like. Due to the doctrine of argument-based estoppel, the examiner may rest assured that, as a matter of law, <u>no</u> person would be found to infringe Claim 18 or Claim 28 if the clocks of the challenged charge pumps employed only waveforms that are very similar to those described or suggested in the charge pump prior art of record. To permit the

possibility that a charge pump infringed Claim 18 or Claim 28, the output of the clock of such charge pump would have to be significantly more sine-like than any in the charge pump prior art of record. Thus, as a practical matter the examiner's complaint is addressed quite effectively by operation of law.

In view of the plain meaning of "significantly sine-like," and of the limitation of scope resulting from the legal doctrine of argument estoppel, the term has a well-defined range of coverage. As such, the examiner is respectfully requested to withdraw this ground of rejection for once and all, barring discovery of otherwise suitable charge pump prior art describing a truly sine-like clock waveform.

Rejections Under 35 USC 103

Remarks set forth immediately below address an issue relevant to numerous grounds of rejection. Subsequent remarks address specific grounds of rejection, which are grouped according to the claims thereby rejected.

General Remarks: Non-Charge Pump Prior Art

It is respectfully submitted that the field of charge pumps is extremely well developed; such a thoroughly explored area of technology may fairly be referred to as a "crowded field." For example, the record of the prosecution of this application is replete with dozens of charge-pump references, and hundreds more are available. Inventors and experts have been incorporating appropriate aspects of electronics into charge pumps for many years, and it may reasonably be asserted that all aspects of electronics that are obviously suitable for charge pumps have already been incorporated into actual charge pumps, as the extensive body of charge pump prior art that is available abundantly demonstrates.

Despite the extensive availability of prior art references directed to charge pumps, the examiner finds it necessary to resort to non-charge pump prior art, such as Yamishiro, to cobble together the features required by many of the Applicants' claims. The Applicants respectfully submit that such appeals to non-charge pump prior art are generally unwarranted in this crowded field. The obviousness of a charge pump is fairly determined in view of the prior art of charge pumps, not in view of amplifiers, voltage-controlled oscillators, etc. Charge pumps have their own requirements, and traditional thinking in charge pumps has taken certain paths. If now, in this crowded field, inventors develop a charge pump that is nonobvious over the volumes of prior charge pump developments, such new charge pump is properly worthy of patent protection.

That either passive coupling or capacitive coupling is known has not been disputed, nor has it been argued that any narrow details of the features required by the Applicants' claims are, in and of themselves, inherently novel. The claims require combinations of cooperating elements (or steps) that together define a charge pump that is novel and nonobvious over the prior art of charge pumps.

The examiner has searched repeatedly in an effort to demonstrate that the Applicants' claims are obvious, and the Applicants' representatives have also searched for relevant prior art. Consequently, the prosecution record includes many dozens of references describing prior art charge pumps. The field of charge pumps is old, crowded, and well-developed, and it is therefore respectfully submitted that to incorporate non-charge pump features in a manner not previously done in charge pumps is suggestive of nonobviousness. The examiner clearly cannot support an obviousness rejection of many of the Applicants' claims without relying on assertions that a skilled person would modify perfectly functional aspects of prior art charge pumps in accordance with non-analogous prior art. This very fact implies that the claims thus rejected are, contrary to the examiner's assertion, nonobvious. In view of the crowded nature of this field, the Applicants respectfully submit that resorting to such nonanalogous art is, in most instances, evidence of an over-zealous effort to try to cobble together an argument for obviousness using improper hindsight.

No charge pump prior art of record has fairly suggested the inventions defined by the Applicants' claims, despite exhaustive searching. This is a proper basis for finding nonobviousness. It is respectfully submitted that nonanalogous prior art, such as Yamashiro, cannot properly render obvious claims to charge pumps in the absence of problems unsatisfactorily resolved in the prior art of charge pumps.

Non-analogous prior art might be appropriately cited if it addressed a problem unresolved in the prior art of charge pumps. However, the problems addressed by the non-analogous art cited by the examiner, such as clock designs, clock output waveforms, and coupling features, are all common charge pump problems that have been satisfactorily resolved not once, but dozens of times, in the charge pump prior art of record. As to such well-resolved problems, the skilled person has no motivation to modify existing charge pumps with features from nonanalogous prior art, which have not been previously used in charge pumps.

Specific Grounds for Rejection of Claims 18 and 49:

On **page 6** of the current Office Action, the Examiner rejects Claims 18-19 and 49 over Imamiya. This ground of rejection is respectfully traversed. The remarks below demonstrate that Claims 18 and 49 are nonobvious over Imamiya, Imamiya in view of Pfiffner, and Imamiya in view of Ito and further in view of Yamashiro; and that Claim 18 is nonobvious over Imamiya in view of Pfiffner and further in view of Ito, and that Claim 49 is nonobvious over Imamiya in view of Pfiffner and further in view of Clark. The remarks thereby also demonstrate that all claims properly depending from either of these independent claims, such as Claim 19, are nonobvious over the asserted combinations of references.

The Examiner points to Fig. 15B of Imamiya as showing a charge pump apparatus. It is respectfully submitted that Fig. 15B does not show a charge pump, but rather a "potential converter" (col. 4 lines 29-30), which is crucially different, and serves a very different purpose, from a charge pump. Potential converter

details are illustrated in Figs. 7, 8, 9 and 15A-B, and used as item "5" in Figs. 4 and 14. Potential converters are disposed in series with a clock signal, rather like a buffer for upconverting a clock signal to a higher voltage (see item 5 of Fig. 4 with col. 5 lines 26-30, and items 5 of Fig. 14 with col. 10 line 35 - col. 11 line 29; see also col. 7 line 46 - col. 8 line 20). The output of potential converters is reset to zero every clock cycle; in the case of Fig. 15B, such resetting is performed by QN14.

As such, the potential converter circuit illustrated in Fig. 15B of Imamiya fails to disclose either a charge pump apparatus or an output supply, both of which are required by all of the claims rejected on this ground. The output of Fig. 15B switches between zero volts and a high voltage every clock cycle, and is thus nothing like a voltage supply output from a charge pump. Accordingly, Fig. 15B of Imamiya fails to anticipate or render obvious the inventions claimed in Claim 18 or Claim 43, let alone Claim 19, which is further distinguished over Claim 18 from which it depends.

The Examiner also cites Pfiffner in this regard, though for obscure reasons. Pfiffner is directed to high-speed sample and hold circuits, and has little or nothing to do with charge pumps. Pfiffner, having no charge pump circuitry, cannot remedy the charge-pump specific deficiencies of Imamiya that are pointed out above in the Examiner's rejection based on Imamiya. In any event, for reasons set forth more fully in the subsection "General Remarks: Non-Charge Pump Prior Art" above, one of ordinary skill in the art would not resort to features found in Pfiffner (but not found in charge pump prior art) for modifying a charge pump.

Though the examiner's reliance on Figure 15B is unavailing because the figure does not illustrate a charge pump, the following remarks address two types of charge pumps disclosed in Imamiya, including one type in figure 5 and another type in figure 10, with respect to Claims 18-19 and 49. The charge pump of figure 5 uses passive transfer capacitor coupling switches (diode-connected FETs "QN"), has two clock phases φ and φ-inverse, and draws all output current from the clock outputs. Thus, this charge pump fails to disclose either the "control node" (of a TC discharge switch or output switching device), or the "single phase clock," both of which are required by each of Claims 18 and 49; and these omissions are not remedied by Pfiffner. The charge pump of figure 10 also fails to anticipate or render obvious (in combination with Pfiffner) these claims, though for different reasons. For example, the output voltage in Fig. 10 is switched via QN73, which is not controlled directly by or coupled directly to the clock. Due to this construction, the charge pump described by figure 10 of Imamiya fails to disclose several aspects of the requirements set forth in element (d) of the Applicants' Claim 18, including (underlining added for emphasis): "to provide a single-phase charge pump clock output <u>coupled</u> passively, without conveying substantial transfer current, ... to <u>control nodes</u> of <u>each</u> of the output switching devices." Again, Pfiffner does not describe charge pumps and therefore cannot remedy these omissions by Imamiya, nor would it be obvious to draw features from the non-

analogous art of Pfiffner. Consequently, Claims 18 and 49 are neither anticipated by, nor obvious over, the Imamiya and Pfiffner references, whether taken alone or together.

On **page 14** of the current Office Action, the examiner rejects Claims 18 and 49 (among others) as obvious over Imamiya in view of Ito and further in view of Yamashiro. This ground of rejection is respectfully traversed at least for reasons set forth above in the subsection "General Remarks: Non-Charge Pump Prior Art," and also for further reasons set forth below.

Imamiya, even in view of Ito, fails to teach, disclose, or fairly suggest all of the requirements of element (d) of Claim 18, or of element (a) of Claim 49, as described in remarks set forth above. Yamashiro contains no disclosure that could remedy those omissions, even were it combined with Imamiya and Ito.

To support this ground of rejection, the examiner states "Also, this capacitive coupling [of Yamashiro] is one type of passive coupling, rendering claim 18 obvious." While it is readily acknowledged that passive coupling has been known since electronics were first invented, it is respectfully observed that passive coupling has not been used as claimed by the Applicants in Claims 18 and 49 in any of the volumes of charge pump references that are of record in the prosecution of this application. Yamashiro does not disclose a charge pump, let alone a reason to use passive coupling in a charge pump in the manner required by Claims 18 and 49, nor does Imamiya provide any apparent reason for such a change. Thus, this combination of references fails to render obvious either Claim 18 or Claim 49, or any claim properly depending from one of these independent claims.

On **page 16** of the current Office Action, the Examiner rejects Claims 20 and 22-23 (which depend from Claim 18) as obvious over Imamiya in view of Pfiffner, and further in view of Ito. This ground of rejection is respectfully traversed. Remarks set forth above in regard to the Examiner's rejection of Claims 18 and 49 over Imamiya in view of Pfiffner demonstrate that this combination of references fails to disclose either the "control node" (of a TC discharge switch or output switching device), or the "single phase clock," both of which are required by each of Claims 18 and 49. Ito is not charge pump prior art, and would not be followed for designing charge pumps. Even were Ito followed, it contains no disclosure, teaching or suggestion that would remedy the noted omissions of Imamiya and Pfiffner. Accordingly, this ground of rejection fails to render obvious Claim 18 (or Claim 49), and thus also fails to render obvious Claims 20 and 22-23, which properly depend from Claim 18.

On **page 17** of the current Office Action, the Examiner rejects Claims 50-51 and 53 as obvious over Imamiya in view of Pfiffner, and further in view of Clark. This ground of rejection is respectfully traversed. First, remarks set forth above amply demonstrate that Imamiya, even if combined with Pfiffner, fails to teach, disclose or fairly suggest all of the limitations of element (a) of Claim 49, from which Claims 50-51 and 53

depend. The examiner intends to rely on Clark as teaching the use of a plurality of discharging switches in a charge pump circuit, but Clark does not teach such use. Clark is exclusively directed to providing a high-voltage control voltage for switches. Clark's Fig. 2 is a circuit including a control voltage circuit for generating a control voltage for a switch (col. 2 lines 57-61). The output of the switched capacitor 30 is not a voltage supply, as required by Claim 49, but instead is a control voltage for another switch (14). The circuit pointed to by the Examiner, which includes capacitor 30, does not transfer current to an output voltage supply: the switch 14 transfers no significant current from capacitor 30 to the load 18. The circuit is thus merely a level-shifting driver, not a charge pump.

Indeed, Clark explicitly distinguishes the subject matter of the patent from charge pumps, stating (col. 1 lines 52-57):

> A charge pump, which generates an output voltage in response to a lower input voltage, is sometimes used to provide the necessary FET gate drive voltage. However, like the bootstrap circuit, the charge pump does not provide any isolation between the input voltage source and the power switch.

Clark therefore fails to disclose the features relied upon by the examiner, and also fails to remedy the deficiencies noted above for Imamiya, Pfiffner, and Ito. Not being charge pump art, Clark would not in the first instance be followed by one of ordinary skill in the art to design a charge pump, a contention further supported in the subsection "General Remarks: Non-Charge Pump Prior Art" above. A combination of Clark with Imamiya and Pfiffner would, in any event, not support *prima facie* obviousness of Claim 49, because Clark lacks the same required features as are noted to be missing from Imamiya, Pfiffner, and Ito in the remarks set forth above.

On **page 26** of the current Office Action, the examiner rejects Claims 1-4, 10, 12, 14, 16, 43-44, 48, 50-51, 53 and 57-58 as obvious over Tasdighi in view of Yamauchi. The application of this ground of rejection to other claims is considered in other subsections that are pertinent to such claims. The remarks set forth immediately below address this ground of rejection as applied to Claims 50-51 and 53, which each properly depend from independent Claim 49, and support a conclusion that this combination of references fails to render obvious even Claim 49, thus demonstrating the nonobviousness of each of Claims 50-51 and 53 over this combination of references.

In the Final Rejection issued August 10, 2005 the examiner rejected Claim 49 on this same ground, over Tasdighi in view of Yamauchi (see Amended Appeal Brief section VII. B.1.k Rejection of Independent Claim 49 over Tasdighi in view of Yamauchi). It is respectfully submitted that all reasonable interpretations of these references were addressed in the Amended Appeal Brief remarks, and not just the support identified

by the examiner in the Final Rejection; as such, rehashing this ground of rejection is redundant. Nonetheless, some of the examiner's current statement of support for this ground of rejection is addressed below.

The Applicant agrees with the examiner's analysis until he states (underlining added for emphasis): "The charging would occur during periodic first times, and the discharging would occur during periodic second times that are not concurrent with the first times (e.g. both transistors 26 and 27 within its own respective switch SW1 or SW2 will not be full on, or off, at the same time)." The problem with this statement is twofold: first, concurrent charging and discharging does not require any transistor to be "full on;" that requirement is a novelty of the examiner. Second, both transistors conducting simultaneously within a given switch as represented in Tasdighi (SW1 or SW2) is not actually the most likely reason for failing to behave as required by Claim 49. Rather, a condition in which FET 27 of SW1 and FET 26 of SW2 conduct simultaneously is a more likely failure, by means of which the transfer capacitor is "shorted," with both sides of the capacitor connected momentarily to ground. The resultant current spikes would be devastating for purposes of generating noise (the avoidance of which is a primary goal of the subject invention), even if the amount of charge loss was not so much as to cause the circuit to completely fail to operate. This is the expected result in the event, suggested by the examiner, that all of the FETs of both SW1 and SW2 are driven by a single-phase charge pump clock. Thus, Tasdighi fails to support the examiner's contentions due to circuit functionality issues.

The evidence of record further fails to support the examiner's contentions for the following two reasons. First, Tasdighi does not show (nor teach, disclose, or fairly suggest) the use of a single phase charge pump clock passively coupled to the FET switches; Tasdighi is simply not concerned with that level of detail, and makes no direct disclosure. In the absence of such disclosure, Tasdighi cannot serve as evidence that this requirement is known in the prior art. Second, the circuitry of Tasdighi is closely related to that of U.S. Patent 4897774 to Bingham, which is incorporated therein by reference (Tasdighi col. 3 lines 45-47 states "FIG. 4 illustrates a charge pump circuit which is the subject of U.S. Pat. No. 4,897,774, assigned to Maxim Integrated Products, incorporated herein by reference."). The Bingham reference does show this detail of the charge pump clock phases ... and it shows two phases (*e.g.*, 44 and 46 in Fig. 1B of Bingham). The two phases are used to avoid precisely the problem described in the foregoing paragraph. With two clock phases, it is agreed that the charge pump of Tasdighi will operate properly with nonconcurrent charging and discharging. In the absence of two clock phases, a charge pump such as shown in Tasdighi will, so far as is known, fail to satisfy the nonconcurrent conduction requirement of Claim 49.

Thus, there is no support for the examiner's contention that Tasdighi suggests a single-phase charge pump clock passively coupled to all of the transfer capacitor coupling switches. Moreover, evidence referenced in Tasdighi (reference to Bingham) is contrary to the examiner's contention, suggesting instead

that the charge pump clock would actually have two phases. Yet further, an analysis of the circuit (as set forth, for example, in the Amended Appeal Brief) shows that the absence of dual clock phases would result in undesirable shorting of the transfer capacitor. Against these two bits of contrary evidence, Tasdighi contains no evidence supporting the examiner's contention.

Yamauchi cannot remedy the deficiencies of Tasdighi in this regard, having even less detail than Tasdighi. As such, this combination of references cannot support *prima facie* obviousness of Claim 49. The foregoing arguments are set forth in more detail in the Amended Appeal Brief (subsection VII.B.1.k Rejection of Independent Claim 49 over Tasdighi in view of Yamauchi), which is of record in the prosecution of this application. In view of all of these arguments, the examiner is respectfully requested to finally and truly withdraw this ground of rejection of Claims 50-51 and 53, because it fails to render obvious even Claim 49 from which Claims 50-51 and 53 properly depend.

On **page 30** of the current Office Action, the examiner rejects independent Claim 49 as obvious over Tasdighi in view of Yamauchi and further in view of Pfiffner. On **page 31** of the current Office Action, the examiner rejects Claims 50-51 and 53, which depend from Claim 49, as obvious over Tasdighi in view of Yamauchi, further in view of Pfiffner, and yet further in view of Clark. These two grounds of rejection are respectfully traversed for at least the reasons set forth below.

Neither Pfiffner nor Clark discloses a charge pump, and for that reason cannot be expected to (and does not) remedy the charge-pump specific failures of Tasdighi and Yamauchi to suggest a single phase clock, passively coupled to discharge and charge switch control nodes to cause nonconcurrent charging and discharging, in the manner expressly claimed in Claim 49. Consequently, even combining Clark and/or Pfiffner with Tasdighi and Yamauchi fails to support *prima facie* obviousness of Claim 49. The examiner is therefore respectfully requested to withdraw this ground of rejection as to Claim 49, and also as to Claims 50-51 and 53 that properly depend therefrom.

Specific Grounds for Rejection of Claims 1, 43 and 12, 28:

On **page 8** of the current Office Action, the Examiner rejects Claims 1-4, 9-10, 12-14, 16-17, 28-33, 36-41, 43-45 and 48 as obvious over Imamiya in view of Ito. This ground of rejection is respectfully traversed. Claims 2-4 and 9-10 depend from Claim 1, and Claims 44-45 and 48 depend from Claim 43. Claims 13-14 and 16-17 depend from Claim 12, while Claims 29-33 and 36-41 depend from Claim 28. Accordingly, the remarks below requiring a conclusion that each of Claims 1, 43, 12 and 28 are nonobvious over Imamiya in view of Ito also require a conclusion that Claims 2-4, 9-10, 13-14, 16-17, 29-33, 36-41, 44-45 and 48 are nonobvious over this combination of cited references.

The Examiner relies upon Fig. 15A of Imamiya to support this ground of rejection, asserting that Fig. 15B discloses "charge pump apparatus that generates output voltage supply OUT." Remarks set forth above with respect to Claims 18 and 49 demonstrate that such reliance is misplaced, because Fig. 15A is not even a charge pump, and thus the examiner's stated support for this ground of rejection fails. Ito cannot remedy such failings, because Ito also fails to disclose a charge pump.

However, as noted in remarks set forth above in regard to Claims 18 and 49, Imamiya does disclose charge pumps (*e.g.* Figs. 5 and 10). Those charge pumps fail to suggest at least the features for which the examiner relies upon Ito in the instant ground of rejection: first, a ring oscillator having not more than three stages that serves as the charge pump clock (Claims 1 and 43); and second, a charge pump clock having a substantially sine-like output (Claims 12 and 28). Accordingly, this ground of rejection is, at best, cumulative of the grounds of rejection of these same numbered claims over Tasdighi in view of Ito that were thoroughly discussed in the Amended Appeal Brief submitted January 5, 2007 in respect of the subject application (see Amended Appeal Brief, sections VII.B.3.a Rejection of Independent Claim 1 over Tasdighi in view of Ito, VII.B.3.c Rejection of Independent Claim 43 over Tasdighi in view of Ito, VII.B.3.e Rejection of Independent Claim 12 over Tasdighi in view of Ito, and VII.B.3.g Rejection of Independent Claim 28 over Tasdighi in view of Ito).

Briefly, Ito is not charge pump art, but Voltage Controlled Oscillator (VCO) art. While it is acknowledged that both substantially sine-like wave outputs and three-stage ring oscillators are well known, and are very appropriate for VCOs, it is respectfully submitted that these features, as claimed by the Applicants, have been thought unsuitable for charge pumps. Moreover, both the examiner and the Applicants' representative have failed to find an example of such combinations, even among pluralities of charge pump references, after extensive searching. It is respectfully submitted that this failure constitutes persuasive evidence of the nonobviousness of the claimed combinations. In view of the crowding in the field of charge pumps, it is respectfully submitted that it would be nonobvious to modify charge pumps in accordance with nonanalogous art such as Ito in the absence of a clear reason (other than the Applicants' teaching) to do so. A conclusion that it is unobvious to resort to non-charge pump prior art for elements of a charge pump is supported in more detail in the subsection "General Remarks: Non-Charge Pump Prior Art" that is set forth above.

The rationale the examiner presents as to why Imamiya would be modified in accordance with the nonanalogous art of Ito is merely a conclusory assertion that because an oscillator is used in Imamiya , it would be obvious to use the oscillator of Ito. However, charge pumps have special requirements that are not the same as those of a VCO. In particular, VCOs are often desired to have sinusoidal outputs, for example for communications purposes, while integrated circuit charge pumps desire sharp-edged clocks for precise switch

timing. Imamiya does not suggest that one should use oscillators previously thought unsuitable for charge pumps, and Ito makes no suggestion that the oscillators disclosed therein for VCOs should be used in charge pumps. Thus there is zero positive motivation for such a modification from nonanalogous art. However, the prior art of charge pumps includes negative motivation for combination: as noted in the above-identified portions of the Amended Appeal Brief in regard to Ito, the Hara charge pump reference teaches that ring oscillators for charge pumps should have at least five stages, thus providing negative motivation for such modification. Ring oscillators will have progressively sharper edged outputs as the number of stages rises and the switching time becomes a smaller and smaller proportion of the clock period. Accordingly, the teaching of Hara against using ring oscillators having less than five stages also effectively suggests that charge pump clocks should be relatively sharp-edged outputs, which thus would not be "substantially sine-like."

In view of the foregoing, in view of the "General Remarks: Non-Charge Pump Prior Art" set forth above, and in view of the relevant remarks set forth in the Amended Appeal Brief, it is respectfully submitted that a person of ordinary skill in the art would not be led to deviate from the extensive teaching of the charge pump prior art in order to arrive at the invention as claimed in Claims 1, 43, 18 or 28 by arbitrary combination of Ito with Imamiya, as proposed by the examiner. Yet further, this ground of rejection is merely cumulative of the previously withdrawn rejection of the same claims over Tasdighi in view of Ito. For all of the foregoing reasons, the examiner is respectfully requested to withdraw this ground of rejection as to independent Claims 1, 43, 12 and 28, and as to all of the claims listed above that properly depend from one of those independent claims.

On **page 14** of the current Office Action, the Examiner rejects Claims 3-8, 15, 18, 22-23, 34-35, 46-49 and 54-59 as obvious over Imamiya in view of Ito, and further in view of Yamashiro. Of these, Claims 3-8 properly depend from independent Claim 1, Claims 46-48 properly depend from independent Claim 43, Claim 15 properly depends from independent Claim 12, and Claims 34-35 properly depend from independent Claim 28. This ground of rejection, as applied to independent Claims 18 and 49 and to Claims 22-23 and 54-59 that properly depend from Claim 18 or Claim 49, are considered in remarks set forth above in regard to Claims 18 and 49. Remarks set forth below support a conclusion that none of the independent Claims 1, 43, 12 and 28 are rendered obvious by the cited references, thereby supporting the corollary conclusion that Claims 3-8, 15, 22-23, 34-35 and 46-48 are nonobvious over Imamiya in view of Ito and further in view of Yamashiro, at least by virtue of properly depending from one of Claims 1, 43, 12 and 28.

The remarks set forth above in respect of the rejection of Claims 1, 43, 12 and 28 over Imamiya in view of Ito apply also to this ground of rejection, because Yamashiro is not charge pump prior art and does not remedy any of the deficiencies of the combination of Imamiya and Ito in regard to these claims. Indeed, Yamashiro is not cited by the examiner for the omissions of Imamiya and Ito that are noted above.

Yamashiro discloses a Class B amplifier. There is no "obvious" reason to incorporate random portions of a Class B amplifier into a charge pump circuit. Yamashiro is non-charge pump prior art that would not be followed by one of skill in the charge pump art for designing a charge pump, except perhaps to solve a problem unsolved within the readily available teachings for charge pumps. Even if so combined, however, Yamashiro fails to remedy the omissions and failures of Imamiya and Ito to disclose all of the required elements of any of Claims 1, 43, 12 or 28. These references therefore are unable to support even *prima facie* obviousness of any of independent Claims 1, 43, 12 and 28. As such, the Examiner is respectfully requested to withdraw this ground of rejection of the identified claims.

On **page 20** of the current Office Action, the examiner rejects Claims 1-2, 4, 9-10, 12-14, 16-17, 28-33, 36-41 and 43-45 as obvious over Forbes in view of Ito. Of these, Claims 1, 43, 12 and 28 are independent, while the others properly depend from one of those independent claims. The remarks set forth below demonstrate that Forbes and Ito do not render obvious any of Claims 1, 43, 12 and 28.

As to Claims 1 and 43, Forbes suggests no detail or circuitry whatsoever for the charge pump clocks, let alone the feature details required by Claims 1 or 43. Accordingly, the examiner turns to other prior art to demonstrate that three (or less) stage ring oscillators are known for use with charge pumps. Unfortunately, no charge pump prior art of record teaches, discloses, or fairly suggests such a charge pump oscillator. The examiner therefore turns to non-charge pump prior art, Ito. This is inappropriate for reasons set forth above in detail in "General Remarks: Non-Charge Pump Prior Art."

As noted elsewhere, three-stage current-starved ring oscillators are a fine choice for a VCO, which can tolerate and may even desire a sine-like oscillator output. However, no charge pump prior art of record suggests having slow, sine-like clock outputs, or using three-stage ring oscillators for charge pumps. To the contrary, all of the numerous charge pump references of record that address this issue show a fast-edged clock signal that would be produced by charge pumps having more stages. Moreover, the only charge pump prior art reference addressing the issue of the number of stages, Hara, expressly suggests that at least five stages should be used with charge pumps. The nonanalogous prior art of Ito would not be followed, in view of the abundant evidence in this crowded field of art that teaches, both by implication from the absence of a suggestion for three-stage ring oscillators and by express contrary suggestion, that three-stage ring oscillators were thought unsuitable for use in charge pumps. As such, the three-stage current-starved ring oscillator required by Claims 1 and 43 is nonobvious over the charge-pump prior art of record. The examiner is therefore respectfully requested to withdraw this ground of rejection as to independent Claims 1 and 43, and as to all claims properly depending therefrom, including Claims 2, 4, 9-10, and 44-45.

Claims 12 and 28 are each distinguished at least by their requirement that the charge pump clock must have a substantially sine-like output. Forbes describes asymmetrical trapezoidal waveforms (Figs. 10-11 and particularly 13) that are clearly not substantially sine-like, having none of the rounding and symmetry of sine waves, and the examiner accordingly relies on Ito for this requirement. However, Ito is nonanalogous prior art that would not be followed by a charge pump designer, and especially not to the extent that it contradicts the voluminous teaching of the prior art of charge pumps. The section above subtitled "General Remarks: Non-Charge Pump Prior Art" provides further support for this contention.

While the charge pump prior art of record does not suggest that a clock for driving a charge pump should have a substantially sine-like output waveform, as required by independent Claims 12 and 28, there is no question that precisely sine-like outputs (which are very substantially sine-like) are well known, used, and highly desirable in many circumstances other than as charge pump clocks. Ito provides a fine example of such use. However, dozens of the charge pump prior art references of record teach clock waveforms that are clearly not sine-like, while none teach, disclose or fairly suggest using a waveform that is substantially sine-like. The conclusion that must be drawn from the prior art of record, therefore, is that sine-like outputs have been thought undesirable for charge pump clocks.

On **page 26** of the current Office Action, the examiner rejects Claims 1-4, 10, 12, 14, 16, 43-44, 48, 50-51, 53 and 57-58 as obvious over Tasdighi in view of Yamauchi. The following remarks support a conclusion that this combination of references fails to render obvious any of the independent Claims 1, 43 and 12, thus demonstrating the nonobviousness of Claims 2-4 and 10, 14, 16, 44 and 48, each of which depend from one of the Claims 1, 43 and 12. The application of this ground of rejection to other claims is remarked upon elsewhere in this Response.

The nonobviousness of Claims 1, 43 and 12 over Tasdighi in view of Yamauchi has been thoroughly demonstrated in the Amended Appeal Brief that is of record in this prosecution (see subsections VII.B.1.a Rejection of Independent Claim 1 over Tasdighi in view of Yamauchi, VII.B.1.c Rejection of Independent Claim 43 over Tasdighi in view of Yamauchi, and VII.B.1.f Rejection of Independent Claim 12 over Tasdighi in view of Yamauchi, respectively). In addition to those arguments of record in the Amended Appeal Brief, the following brief remarks are set forth as further support.

Each of Claims 1 and 43 require something akin to a three (or less) stage current starved ring oscillator as a charge pump clock, though the precise language of such requirement is set forth in the claims. Tasdighi barely mentions that ring oscillators would be suitable for charge pumps, hence contributing no disclosure of the required details. As to the ring oscillator described in Yamauchi, it is agreed that Yamauchi describes using a current-starved ring oscillator as a charge pump clock, and agreed that ring oscillators have

odd numbers of stages. However, Figs. 6 & 7 of Yamauchi suggest that more than three stages are used (a meaning conveyed by the " ... " symbol that is inserted between stages in the illustrations), and Yamauchi makes no suggestion to the contrary. This absence of a suggestion that 3-stage ring oscillators should be used is sufficient to render such a limitation nonobvious, but the prior art goes farther, expressly disapproving ring oscillators of less than five stages (for charge pumps). The Hara reference, previously cited by the examiner and of record in this prosecution, suggests that ring oscillators for charge pumps should have at least five stages. The examiner can point to no charge pump prior art of record that provides evidence of the use of three-stage ring oscillators in charge pump clocks; certainly Yamauchi does not. Because evidence that all limitations must be suggested in the cited prior art to support *prima facie* obviousness of any claim, that absence of evidence renders Claims 1 and 43 nonobvious over Tasdighi in view of Yamauchi. Moreover, the further teaching of the charge pump prior art reference Hara that three is not enough stages for a charge pump clock ring oscillator strongly buttresses the conclusion that these claims are nonobviousness over the cited references. Withdrawal of this ground of rejection as to Claims 1 and 43 is therefore clearly proper, and is respectfully requested.

Claim 12 requires a clock waveform that is "substantially sine-like," a requirement demonstrated elsewhere in this Response (Rejections Under 35 USC 112) to be valid and definite. Tasdighi suggests a "pulse train" or "pulses" for the clock, which clearly is not substantially sine-like. Yamauchi makes a similar suggestion: one sentence recites (sentence traversing columns 9-10, underlining added for emphasis): "Oscillation control circuit 41 controls the frequency of clock signal (pulse voltage) CLK oscillated from ring oscillator 39." (See also col. 10 lines 11-14.) "Pulse train" and "pulse voltage" clearly do not constitute suggestion of a "substantially sine-like" waveform, but rather suggest a waveform that is distinctly different from a sine.

The examiner has already withdrawn this same ground of rejection once before. As a person trained in electrical engineering, it is not understood how the examiner can unabashedly insist to the Board of Patent Appeals and Interferences that the "pulse voltage" of Yamauchi is evidence that "substantially sine-like" charge pump clock waveforms are suggested in the prior art. The examiner is earnestly and respectfully requested, instead, to once again withdraw this ground of rejection of Claim 12.

The remarks set forth above support a conclusion that each of independent Claims 1, 43 and 12 is nonobvious over Tasdighi in view of Yamauchi, accordingly supporting a conclusion that all of the claims depending from one of these claims are also nonobvious over this combination of references. As to other claims, this ground of rejection is addressed elsewhere in this Response.

Specific Grounds for Rejection of Claims 24 and 60:

On page 18 of the current Office Action, the Examiner rejects independent Claims 24 and 60, as well as Claims 25, 27, 61 and 66-67 that properly depend from one of these claims, as obvious over Imamiya in view of Yamashiro. This ground of rejection is respectfully traversed. The remarks set forth below demonstrate that Claims 24 and 60 are nonobvious over Imamiya in view of Yamashiro, and consequently also support the corollary conclusion that the other claims rejected on this ground are nonobvious at least by virtue of properly depending from a nonobvious independent claim.

Claim 24 requires, among other features, "a capacitive coupling circuit coupling a charge pump clock output to one of the control nodes corresponding to a source switching device or to an output switching device." Claim 60 requires in part "coupling a first charge pump clock output to a control node of a TC charging switch via a first capacitive coupling network that does not conduct a significant portion of the charge for the output ... [and] coupling a second charge pump clock output to a control node of a TC discharging switch via a second capacitive coupling network that does not conduct a significant portion of the charge for the output."

While it is acknowledged that capacitive coupling is well known in electronic circuit generally, it is respectfully contended that such coupling has not been found suitable for coupling charge pump clocks to charge pump fly capacitor switch circuits, particularly on integrated circuits. Generally, capacitive coupling is not only expensive in terms of integrated circuit real estate, but also reduces the precise control of drive circuit voltage levels that is required by prior art charge pumps. The absence of examples of such coupling in the prior art of charge pumps speaks loudly of the undesirability of such coupling. To require a limitation previously thought undesirable is certainly nonobvious.

The charge pump prior art, such as Imamiya, does not show such capacitive coupling; instead, the examiner can find this common feature only in nonanalogous prior art. For the capacitive coupling required by Claims 24 and 60, the examiner relies upon Yamashiro. Yamashiro is Class B amplifier prior art, not charge pump prior art, and accordingly would not be used to modify a charge pump withouot a compelling motivation, in view of the volume of truly suitable circuitry examples disclosed in the crowded charge pump field. This contention is set forth and supported more fully above in "General Remarks: Non-Charge Pump Prior Art." However, Yamashiro is particularly unlikely as a source of design inspiration for a charge pump, for reasons set forth below.

Yamashiro teaches capacitive coupling for a Class B amplifier processing a sine wave. It has already been noted that the charge pump prior art of record does not suggest anything like (and certainly not "substantially" like) a sine wave output for the charge pump clock. Yamashiro notes that when the clock is

fast enough (digital), there is no problem because the simultaneous conduction time is very short, and hence there is no need for the invention taught by Yamashiro (col. 1 lines 35-42). However, when the clock becomes slow (linear, sinusoidal), simultaneous conduction becomes a problem to which Yamashiro proposes a solution. Prior art charge pumps have avoided any simultaneous conduction problem by keeping clock edges steep and/or using plural clock phases. Having no reason to use slow, analog waveforms, charge pump designers would consequently have no use for the teaching of Yamashiro.

Moreover, the solution of Yamashiro is unsuitable for charge pumps, because that design permits some simultaneous conduction, which is very harmful to the operation of a charge pump. See col. 4 lines 12-17; concurrent conduction is reduced, but not eliminated: "Thus, the period of allowing a through-current to pass becomes short and the power consumption is greatly reduced." While a little simultaneous conduction may be only slightly harmful in the circuit of Yamashiro that is protected by series resistors (such as R_{L1} and R_{L2} in Fig. 1), it would be catastrophic in the low impedance circuits of the fly capacitor switches in a charge pump.

There are many suitable solutions set forth in the prior art of charge pumps for coupling a charge pump clock to other charge pump circuitry. As such, it cannot reasonably be asserted that it is "obvious" to go outside the prior art of charge pumps to modify a perfectly good charge pump according to a design that is clearly unsuitable for charge pumps. To the contrary, modifying a charge pump in accordance with Yamashiro would not only be nonobvious, it would result in an inferior design having undesirable simultaneous conduction of transfer capacitor switches.

For the reasons set forth above, the inventions defined by Claim 24 and Claim 60 are clearly nonobvious over Tasdighi in view of Yamashiro. As such, the examiner is respectfully requested to withdraw this ground of rejection as to independent Claims 24 and 60, and as to all claims properly depending form one of those independent claims.

New Claims

New Claims 68-71 are nonobvious and properly allowable over all of the prior art applied in the current Office Action against any claim from which such claim depends, at least by virtue of properly depending therefrom. New Claims 68-69 exclude the possibility of a single-stage ring oscillator as to all claims depending therefrom, in favor of a preferred embodiment that has exactly (neither less nor more than) three stages, thereby obviating the examiner's rejections in this regard as to most claims. New Claims 70-71 require a feature that further distinguishes these claims over embodiments of an invention defined by Claim 18 or Claim 49, respectively, that rely on a circuit using P-FETs (or N-FETs) having very different threshold voltages from other FETs of the same polarity.

Conclusion

In view of the amendments and remarks set forth above, it is respectfully submitted that each pending claim is now fully in condition for immediate allowance. As such, the Examiner is respectfully requested to withdraw each of his grounds for objection and rejection, and to issue a Notice of Allowance in respect of all pending claims.

The Commissioner is authorized to construe this paper as including a petition to extend the period for response by the number of months necessary to make this paper timely filed. Fees or deficiencies required to cause the response to be complete and timely filed may be charged, and any overpayments should be credited, to our Deposit Account No. **50-0490**.

Respectfully submitted,

9/17/2007

Date: September 17, 2007

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